SPECS
Capacity: 18 gallons
Weight: 38 pounds
Cost: $4,300

A Fuel Cell

There's something inherently unsettling about 43 stock cars loaded with fuel running door handle to door handle at breakneck speeds.

One mistake, and cars start crashing. And anyone who has seen a "big one" can attest to the violence of race cars colliding, flipping and smashing into walls.

In a bygone era, it wasn't unheard of for fuel to leak in such a crash and for sparks to ignite a raging inferno that burned or even killed drivers.

That horror inspired the development of the fuel cell — an apparatus that has significantly reduced the risk of fire in the event of an accident.

Yet while safety is the fuel cell's ultimate purpose, with fuel strategy frequently determining the outcome of a race, manufacturers such as Aero Tec Laboratories dedicate hours to performance-related issues.

—JON GUNN

CONTAINER (1)

Think of the red fuel cell container as an outer shell. Its 18-gauge steel provides impact protection and serves as a stable platform for mounting the fuel cell.

NASCAR rules stipulate the size of the cell, its specific location and the manner in which it is secured.

Before each race, NASCAR officials require each team to pull the fuel cell from the car. The officials then measure the size and location of the fuel cell. They also check how it's secured.

If NASCAR weren't so strict, a team might try to mount the fuel cell a fraction of an inch to the left or right, or front to back in an effort to improve weight distribution. And a tight fit prevents the container from bulging if a team tries to dump in extra fuel.

"It has to be very square, very perfect, very precise," says ATL VP of Sales David Dack. "The days of being more creative with NASCAR have come and gone. We've had our hand slapped over the years."

FILL PLATE (2)

The fill plate is constructed of machined aluminum and has three fittings — one each for the vent tube (L-R in cutaway photo, right), the fuel line from the fuel cell to the engine and the hose used for adding fuel.

A spring-loaded safety valve is attached where fuel enters the fuel cell. The pressure of the fuel flowing in opens the valve. The valve closes when the fuel stops flowing. This system prevents fuel from flowing out if a car gets on its side or upside down.

At Watkins Glen, the fill plate is rotated 180 degrees because refueling at that track takes place on the right side.

BLADDER (3)

Constructed of a Kevlar-reinforced rubber composite, the 18-gallon bladder has over 2,000 pounds of tensile strength.

In ship-in-a-bottle fashion, the bladder is rolled and stuffed into the container via the 6-by-10-inch fill plate opening. It is attached to the container via an aluminum nut ring inside the bladder that is held in place by the 24 bolts securing the fill plate atop the container.

"We get bladders back, many of which that have been subjected to some pretty horrible crashes, and I have yet to see an ATL bladder that has failed in a crash," Dack says.

To maximize fuel capacity, the bladder is designed for an extremely tight fit within the container. Even its seams are on the inside.

"You want to produce a bladder that is so precise that it exactly mirrors the inside dimensions of the container," Dack says. "We're looking for minute advantages in capacity. If you had the seams on the outside, you would have a microscopic air space."

FOAM (4)

Synthetic foam fills much of the inside of the bladder, but due to its large pores, it reduces overall volume by just 5 percent. The foam guards against sloshing of fuel during braking and cornering and also suppresses explosion.

"If the bladder were to be cut on impact and if there is a spark, that spark can ignite fuel vapors, but those vapors are not in a concentrated form," Dack says. "The flame front wouldn't be able to get through the foam quickly enough to ignite all the vapors at once."

COLLECTOR COMPARTMENT (5)

Shaped like the bow of a boat, the collector compartment is built into the bladder. Its triangular shape helps direct fuel into the compartment via two small trap doors — one on either side of the compartment. Once the fuel goes in, it can't flow back into the bladder.

With the exception of the road-course tracks, the compartment is fitted in the right rear corner of the bladder. It's mounted there because as the car turns left, the fuel flows to the right. At the road courses — where there are more right-hand corners than left — it's fitted either in the left rear or center.

Under caution, a driver running low on fuel can often be seen swerving in an attempt to fill the compartment, which has a capacity of .7 gallon.

Once in the box, the fuel is fed into the fuel line via a low-profile polymer pick-up valve.

"We've heard from teams that have won fuel-mileage races where they pulled bladders apart to see how much fuel it had in it, and there's so little [fuel] that you can absorb what remains with one paper towel," Dack says.

Photo: Jim Fluharty

Top and bottom left: Courtesy ATL; Bottom right: Jim Fluharty